Chapter 2: Trends in Adult Smoking Prevalence: An Update

The analysis reported in this chapter updates work that was presented in our last Annual Report[1] and in published articles.[2] The previous analysis found that, from 1990 through 1999, adult smoking prevalence declined faster in Massachusetts than in states without comprehensive tobacco control programs, and that this pattern could not be explained by demographic factors alone. It also showed that the "Massachusetts effect" was most pronounced for males, for persons aged 18-34, for persons who graduated from high school but were not college graduates, and for white non-Hispanic persons. The updated analysis, adding data for 2000, confirms the previous findings.

Introduction

A primary goal of the MTCP and other tobacco control programs is to reduce the prevalence of cigarette smoking by adults. Progress on this goal is slow to occur and difficult to measure. Even when smoking rates decline, it is difficult to be sure that the decline results from the tobacco control program. A decreasing smoking rate in Massachusetts might be caused by the Commonwealth's tobacco control efforts. Alternatively, a decline might result from a national trend. Or a decline might reflect a change in population composition, such as an increase in the proportion of highly educated people or elderly people, who are known to have lower than average smoking prevalence.

Last year's Annual Report examined the question of whether national patterns or demographic factors were causing the pattern of declining prevalence that had been observed in Massachusetts. That analysis compared 1990-1999 trends in adult smoking prevalence rates for Massachusetts and a group of 41 comparison states that did not have comprehensive tobacco control programs for most of the study period. The analysis used data from the Behavioral Risk Factor Surveillance System (BRFSS) and controlled for individuals' demographic characteristics.

Trend analyses for relatively short time series, such as the ten annual observations used in the previous analysis, can yield apparent trends that disappear when a longer period is examined. The principal objective of this year's analysis was therefore to test the stability of the previous findings. The analysis replicates the previous methodology, extending the time period to 2000.

Data Sources and Methods

The data sources and methodology for this analysis replicate those reported last year, except that data for the year 2000 have been added. Data come from the core samples for the Behavioral Risk Factor Surveillance System (BRFSS) for 1990-2000. The BRFSS is a standardized, state-based, random digit-dialed telephone survey of non-institutionalized adults 18 years of age and above. The survey is coordinated by the Center for Disease Control and Prevention (CDC) and conducted by each state.[3,4]

A total of 157,387 respondents from the 2000 BRFSS data for Massachusetts and other states were added to the previous annual BRFSS data from 1990 to 1999. The total 1990-2000 sample included 1,123,858 respondents, of whom 30,289 (2.9 percent) were in Massachusetts and 1,093,569 (97.1 percent) in 41 comparison states. As in the previous analysis, we excluded data from California, which had a comprehensive tobacco control program similar to that in Massachusetts during the period, and seven other states that did not participate in the BRFSS for one or more years between 1990 and 2000. The eight excluded states are thus Alaska, Arkansas, California, Kansas, Nevada, New Jersey, Rhode Island, and Wyoming. In addition, subjects with missing data on one or more demographic variables were excluded from the analysis (1.1 percent).

Respondents in the 41 comparison states represent a population that was not subject to comprehensive tobacco control programming for most of the study period. However, tobacco control programming was not entirely absent from the comparison states. Most states implemented tobacco control initiatives after funds became available from the Master Settlement Agreement between the states and the major tobacco companies, with implementation typically beginning in 2000.[5] Several states–notably Arizona, Florida, and Oregon–began programs in 1996-1997. In addition to these comprehensive statewide programs, many states have implemented selected tobacco control initiatives or implemented comprehensive programs on a less than statewide basis. Prevalence trends in the comparison states may therefore reflect some influence of tobacco control programming, particularly in the final year or two of the analysis period.

To be consistent with the previous analysis, current smokers in 2000 were defined as those subjects who answered either "every day" or "some days" to the question: "Do you smoke cigarettes every day, some days or not at all?" The BRFSS wording of the smoking question changed slightly in 1996, and the previous analysis suggested that the new wording led to an increase in self-reported smoking prevalence. Because the change occurred for all states, including Massachusetts, it should have little or no effect on the comparison of trends between Massachusetts and the 41 states.

As in the previous report, this analysis tests the null hypothesis that there was no difference in the time trends of current smoking prevalence between Massachusetts and the 41 comparison states, controlling for demographic factors. The analysis then tests the sub-hypotheses that there were no differences between Massachusetts and the comparison states in the trends for demographic subgroups defined in terms of sex, age, race, and education level.

Multiple logistic regression models were used for the analysis. Conclusions regarding statistical significance are based on tests of the model coefficients. The models were then used to construct standardized prevalence estimates, which are shown in the tables and graphs in this chapter. The standardized estimates take into account differences in demographic composition (differences between Massachusetts and the 41 comparison states, and differences over time) by imposing a common demographic composition, which was directly calculated from the combined sample of Massachusetts and the comparison states. Proc Logistic from SUDAAN was used in analyses to account for the stratified sampling design of the BRFFS. More detailed descriptions of the data sources and methods can be found in the previous report.[1]

Prevalence Trends in Massachusetts and the 41 Comparison States

Current smoking prevalence declined more rapidly in Massachusetts than in the 41 comparison states from 1990-2000, and the difference in trends is statistically significant ($p = 0.01$) (Exhibit 2.1). This finding was unchanged from the 1990-1999 analysis even though the estimated prevalence for Massachusetts and the 41 states converged somewhat from 1999 to 2000. For the period as a whole, Massachusetts experienced an 0.9 percent annual decline ($p^{trend} < 0.10$) in the adjusted smoking prevalence while the 41 comparison states experienced a 0.4 percent annual increment ($p^{trend} < 0.01$) in the same smoking prevalence measure. The difference between the two is statistically significant ($p < 0.01$).

Exhibit 2.1
Adjusted smoking prevalence and trends: Massachusetts and US (41 comparison states) [a]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Massachusetts											
Adjusted prevalence	22.7%	21.4%	22.9%	20.2%	20.6%	21.8%	22.6%	20.2%	20.8%	19.5%	20.5%
Relative to 1990	-	-5.6%	0.8%	-10.9%	-9.4%	-3.9%	-0.3%	-11.0%	-8.5%	-13.9%*	-9.5%
US (41 States)											
Adjusted prevalence	22.0%	21.8%	21.2%	21.0%	21.4%	21.5%	22.7%	22.4%	22.4%	22.2%	21.7%
Relative to 1990	-	-0.9%	-3.9%**	-4.8%**	-2.9%†	-2.2%	3.1%*	1.9%	1.7%	0.9%	-1.6%

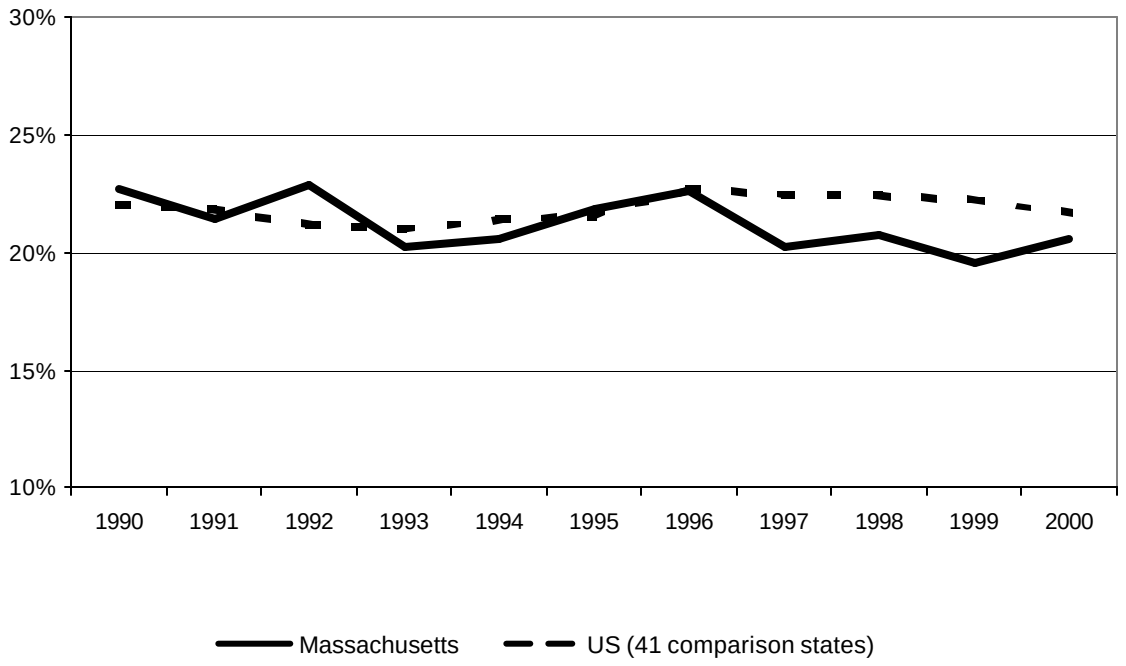
1990-2000 Trends	**MA trend**	**US Trend**	**Trend comparison**[b]
Odds ratio	0.989†	1.004**	0.984**
Avg. annual change[c]	-0.86%	0.31%	

a Adjusted for sex, age, education, and race/ethnicity

b Odds ratio of interaction term (Massachusetts by year)

c Derived from coefficient on trend variable, not from annual adjusted prevalence

p-value of logit coefficients: † = <0.10, * = <0.05, ** = <0.01



Trends by Sex

The adjusted smoking prevalence trended significantly downward for Massachusetts men from 1990-2000 ($p^{trend} < 0.05$) (Exhibit 2.2). The trend for Massachusetts women was also downward, but the trend was not statistically significant at conventional levels. In contrast, the trends for men and women in the 41 comparison states were virtually identical to each other (a separate analysis comparing the trends for men and women in Massachusetts found them to be significantly different). The trends for Massachusetts and the 41 comparison states are significantly different for men ($p < 0.05$), but not for women.

Again these patterns are consistent with those presented in the previous report. The adjusted prevalence estimate was slightly higher in 2000 than 1999 for both men and women in Massachusetts, but the trends over the period as a whole remained the same.

Trends by Age Group

The youngest of the three age groups (age 18-34, 35-54, and 55+) showed a significant difference between the adjusted prevalence trends in Massachusetts and the 41 states (Exhibit 2.3). The Massachusetts decline from 1990-2000 was small and not statistically significant. However, it contrasted sharply with the increasing trend observed in the 41 comparison states ($p < 0.01$).

The oldest group actually showed the strongest decline in adjusted smoking prevalence from 1999-2000. In Massachusetts, the trend for persons age 55+ amounted to a reduction of 2.5 percent per year ($p^{trend} < 0.05$). However, this group was also experiencing a strong decline in the 41 comparison states (1.3 percent per year, $p^{trend} < 0.01$). Although the estimated decline in Massachusetts is greater, the difference is not statistically significant.

Trends by Education Level

Consistent with previous analysis, the downward trend in adjusted smoking prevalence was observed most strongly in Massachusetts for respondents who had graduated from high school but not from college ($p^{trend} < 0.05$) (Exhibit 2.4). For this group, the downward trend in Massachusetts was significantly different from the slight upward trend in the 41 comparison states ($p < 0.01$). This pattern remained the same as reported previously despite some convergence of the Massachusetts and 41-state adjusted prevalence estimates in 2000.

For the other two education groups, 1990-2000 trends in Massachusetts did not differ significantly from those in the 41 comparison states. Within Massachusetts, the trend estimate was not statistically

significant either for those with less than a high school education or for those who had a college degree or higher.

Trends by Race/Ethnic Group

Non-Hispanic Whites experienced a significantly greater decline in smoking prevalence in Massachusetts than in the 41 US comparison states during the 11 year period ($p < 0.01$) (Exhibit 2.5). This trend difference was particularly evident in the last four years of the period. For the period as a whole, Massachusetts showed a marginally significant decline ($p^{trend} < 0.10$), while the trend for the 41 states was upward. This result as that previously seen for the 1990-1999 period.

For the Black non-Hispanic and the Hispanic groups, small sample sizes in Massachusetts make it difficult to see trends. Comparative analyses found no significant differences between the Massachusetts and 41-state prevalence trends for these two groups.

Exhibit 2.2

Adjusted smoking prevalence and trends by sex: Massachusetts and US (41 comparison states) [a]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males											
Massachusetts											
Adjusted prevalence	25.0%	21.4%	24.8%	20.4%	22.6%	22.8%	23.1%	21.6%	22.2%	19.5%	20.6%
Relative to 1990	-	-14.2%	-0.6%	-18.2%†	-9.6%	-8.7%	-7.3%	-13.4%	-11.1%	-21.8%*	-17.3%*
US (41 states)											
Adjusted prevalence	23.8%	23.9%	23.1%	22.8%	23.0%	23.9%	24.9%	24.8%	24.7%	24.3%	23.2%
Relative to 1990	-	0.3%	-3.1%	-4.2%*	-3.7%†	0.1%	4.5%*	4.0%†	3.5%†	2.1%	-2.5%
1990-2000 Trends			**MA trend**			**US Trend**				**Trend comparison** [b]	
Odds ratio			0.982*			1.004*				0.978*	
Avg. annual change[c]			-1.38%			0.33%					
Females											
Massachusetts											
Adjusted prevalence	20.6%	21.2%	21.1%	20.1%	18.8%	20.9%	22.1%	19.0%	19.4%	19.6%	20.4%
Relative to 1990	-	3.0%	2.2%	-2.6%	-8.9%	1.6%	7.0%	-7.9%	-5.7%	-5.0%	-1.1%
US (41 states)											
Adjusted prevalence	20.4%	20.0%	19.4%	19.3%	20.0%	19.5%	20.7%	20.4%	20.4%	20.3%	20.2%
Relative to 1990	-	-2.1%	-4.8%*	-5.4%**	-2.1%	-4.6%*	1.7%	-0.2%	-0.1%	-0.5%	-0.7%
1990-2000 Trends			**MA trend**			**US Trend**				**Trend comparison** [b]	
Odds ratio			0.996			1.004*				0.990	
Avg. annual change[c]			-0.35%			0.29%					

a Adjusted for age, education, and race/ethnicity

b Odds ratio of interaction term (Massachusetts by year)

c Derived from coefficient on trend variable, not from annual adjusted prevalence

p-value of logit coefficients: † = <0.10, * = <0.05, ** = <0.01

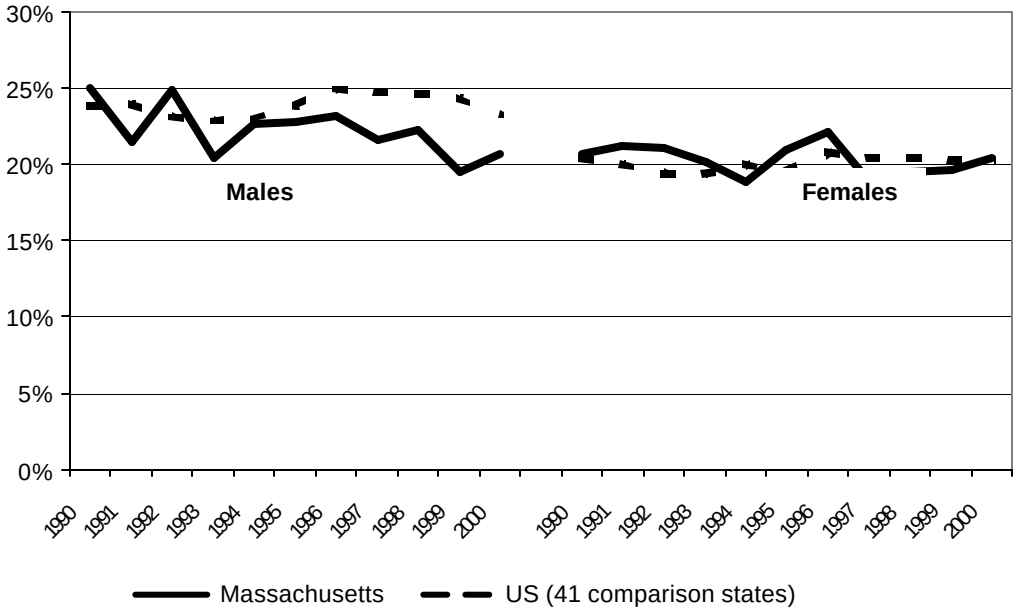


Exhibit 2.3
Adjusted smoking prevalence and trends by age: Massachusetts and US (41 comparison states) [a]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Age 18-34											
Massachusetts											
Adjusted prevalence	24.7%	26.0%	26.2%	24.7%	20.8%	25.3%	24.0%	22.5%	25.8%	22.4%	25.7%
Relative to 1990	-	5.6%	6.2%	0.2%	-15.5%	2.6%	-2.8%	-8.8%	4.7%	-9.2%	4.1%
US (41 states)											
Adjusted prevalence	23.4%	23.8%	23.3%	23.7%	23.7%	24.3%	26.2%	26.4%	26.0%	26.4%	26.0%
Relative to 1990	-	1.7%	-0.4%	1.3%	1.3%	3.9%	12.2%**	12.9%**	11.5%**	12.9%**	11.4%**
1990-2000 Trends			**MA trend**			**US Trend**			**Trend comparison** [b]		
Odds ratio			0.9952			1.0195*			0.9744**		
Avg. annual change[c]			-0.36%			1.46%					
Age 35-54											
Massachusetts											
Adjusted prevalence	26.3%	24.2%	25.5%	23.8%	26.7%	27.4%	26.0%	26.1%	25.0%	22.3%	23.9%
Relative to 1990	-	-8.0%	-2.7%	-9.3%	1.6%	4.5%	-0.8%	-0.6%	-4.9%	-15.1%	-9.1%
US (41 states)											
Adjusted prevalence	26.3%	25.6%	25.1%	24.4%	25.1%	25.3%	26.5%	26.1%	25.8%	25.4%	24.9%
Relative to 1990	-	-2.7%	-4.4%*	-7.1%**	-4.5%*	-3.9%†	0.7%	-0.8%	-1.9%	-3.4%†	-5.4%**
1990-2000 Trends			**MA trend**			**US Trend**			**Trend comparison** [b]		
Odds ratio			0.9921			0.9993			0.9919		
Avg. annual change[c]			-0.60%			-0.05%					
Age 55 and above											
Massachusetts											
Adjusted prevalence	18.1%	14.6%	17.8%	13.1%	15.6%	13.6%	19.6%	12.5%	12.2%	14.9%	12.9%
Relative to 1990	-	-19.4%	-1.7%	-27.6%†	-13.9%	-25.2%	8.0%	-30.9%*	-32.8%*	-18.0%	-29.0%*
US (41 states)											
Adjusted prevalence	16.8%	16.2%	15.0%	14.7%	15.1%	14.7%	15.1%	14.4%	14.9%	14.4%	13.4%
Relative to 1990	-	-3.4%**	-10.5%**	-12.3%**	-10.2%**	-12.7%**	-10.2%**	-14.3%**	-11.1%**	-14.1%**	-20.4%**
1990-2000 Trends			**MA trend**			**US Trend**			**Trend comparison** [b]		
Odds ratio			0.9750*			0.9867**			0.9902		
Avg. annual change[c]			-2.13%			-1.53%					

a Adjusted for sex, educat ion, and race/ethnicity

b Odds ratio of interaction term (Massachusetts by year)

c Derived from coefficient on trend variable, not from annual adjusted prevalence

p-value of logit coefficients: † = <0.10, * = <0.05, ** = <0.01

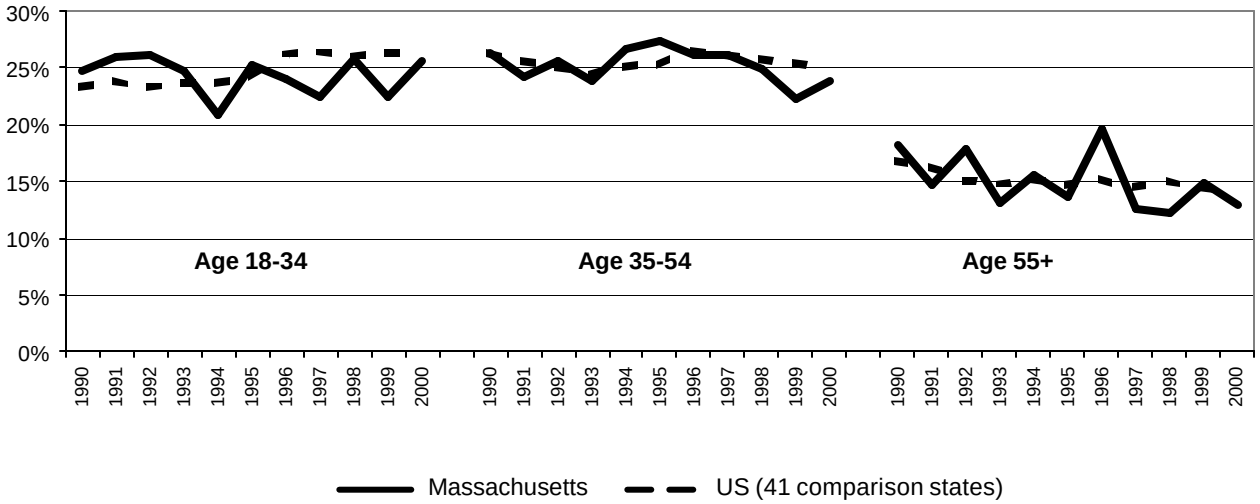


Exhibit 2.4
Adjusted smoking prevalence and trends by education: Massachusetts and US (41 comparison states) [a]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Less than high school											
Massachusetts											
Adjusted prevalence	28.8%	22.1%	26.1%	27.2%	29.8%	25.0%	29.2%	25.1%	28.5%	28.0%	26.7%
Relative to 1990	-	-23.5%	-9.5%	-5.6%	3.3%	-13.5%	1.2%	-12.9%	-1.1%	-2.9%	-7.5%
US (41 states)											
Adjusted prevalence	26.9%	26.9%	27.8%	27.9%	25.6%	26.3%	30.8%	29.4%	30.1%	29.2%	28.0%
Relative to 1990	-	-0.1%	3.1%	3.6%	-4.9%	-2.2%	14.3%**	9.2%**	11.7%**	8.3%*	4.0%
1990-2000 Trends			**MA trend**			**US Trend**			**Trend comparison** [b]		
Odds ratio			1.010			1.013**			0.996		
Avg. annual change[c]			0.72%			0.94%					
High school but not college graduates											
Massachusetts											
Adjusted prevalence	25.5%	25.6%	27.1%	23.2%	22.9%	26.3%	26.5%	22.5%	23.8%	21.3%	22.9%
Relative to 1990	-	0.4%	6.0%	-9.3%	-10.1%	3.0%	3.8%	-12.0%	-6.7%	-16.5%*	-10.3%
US (41 states)											
Adjusted prevalence	25.5%	25.3%	24.3%	24.4%	25.1%	25.3%	26.2%	26.1%	26.0%	26.0%	25.4%
Relative to 1990	-	-0.6%	-4.5%**	-4.3%*	-1.5%	-0.6%	2.7%	2.2%	2.1%	2.0%	-0.2%
1990-2000 Trends			**MA trend**			**US Trend**			**Trend comparison** [b]		
Odds ratio			0.984*			1.006**			0.976**		
Avg. annual change[c]			-1.17%			0.41%					
College graduates and above											
Massachusetts											
Adjusted prevalence	13.0%	12.5%	11.1%	11.6%	12.1%	11.1%	11.3%	11.4%	11.8%	10.6%	11.5%
Relative to 1990	-	-3.7%	-14.8%	-10.6%	-6.7%	-15.0%	-13.6%	-12.2%	-9.2%	-19.0%	-11.6%
US (41 states)											
Adjusted prevalence	14.6%	14.1%	13.1%	12.3%	13.4%	12.9%	13.3%	13.2%	12.8%	12.6%	12.4%
Relative to 1990	-	-3.7%	-10.0%**	-16.1%**	-8.4%*	-11.6%**	-8.8%**	-9.8%**	-12.3%**	-13.9%**	-15.0%**
1990-2000 Trends			**MA trend**			**US Trend**			**Trend comparison** [b]		
Odds ratio			0.993			0.987**			1.007		
Avg. annual change[c]			-0.59%			-1.10%					

a Adjusted for sex, age, and race/ethnicity

b Odds ratio of interaction term (Massachusetts by year)

c Derived from coefficient on trend variable, not from annual adjusted prevalence

p-value of logit coefficients: † = <0.10, * = <0.05, ** = <0.01

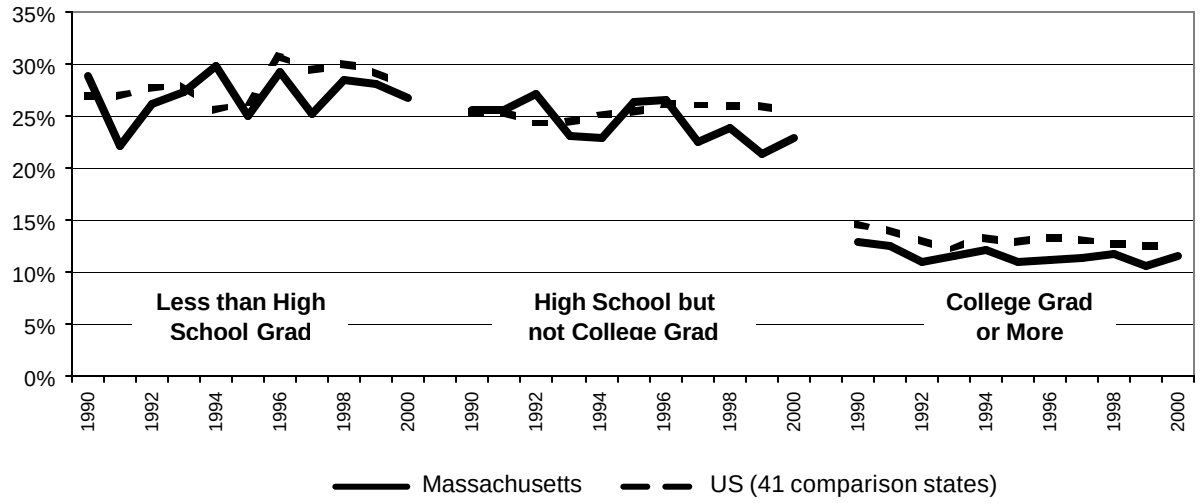


Exhibit 2.5

Adjusted smoking prevalence and trends by race: Massachusetts and US (41 comparison states) [a]

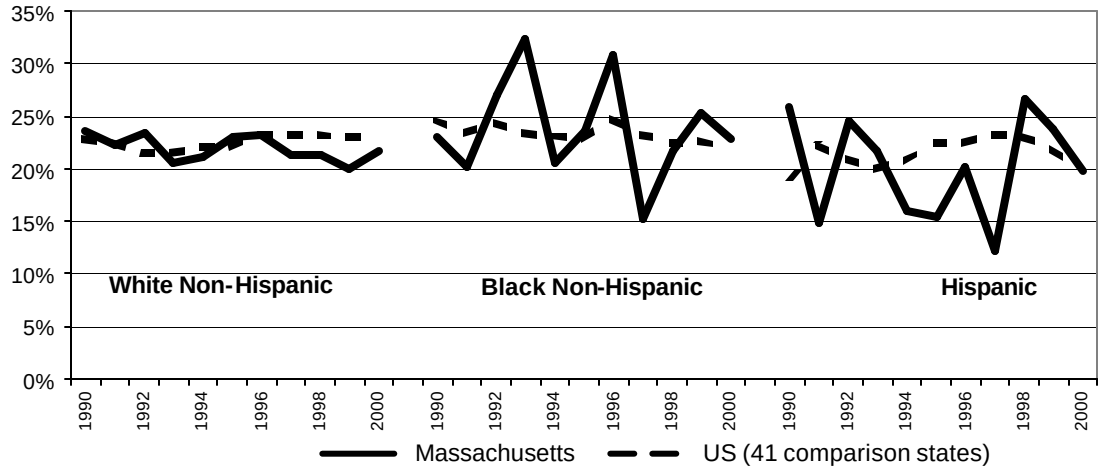
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
White non-Hispanic											
Massachusetts											
Adjusted prevalence	23.6%	22.3%	23.4%	20.6%	21.2%	23.0%	23.2%	21.3%	21.3%	20.0%	21.7%
Relative to 1990	-	-5.4%	-0.7%	-12.6%	-10.3%	-2.4%	-1.8%	-9.6%	-9.5%	-15.1%†	-8.2%
US (41 states)											
Adjusted prevalence	22.8%	22.4%	21.6%	21.5%	22.0%	22.1%	23.3%	23.2%	23.2%	23.1%	22.8%
Relative to 1990	-	-1.5%	-5.2%**	-5.4%**	-3.3%*	-2.9%†	2.4%	1.9%	1.8%	1.4%	0.2%
1990-2000 trends			**MA trend**			**US Trend**				**Trend comparison** [b]	
Odds ratio			0.9890†			1.0064**				0.9823**	
Avg. annual change[c]			-0.86%			0.49%					
Black non-Hispanic											
Massachusetts											
Adjusted prevalence	23.1%	20.1%	26.9%	32.3%	20.6%	23.7%	30.7%	15.3%	21.7%	25.3%	22.8%
Relative to 1990	-	-12.9%	16.7%	40.0%	-10.7%	2.6%	33.2%	-33.7%	-5.8%	9.5%	-1.2%
US (41 states)											
Adjusted prevalence	24.7%	23.4%	24.3%	23.4%	23.1%	22.9%	24.7%	23.3%	22.4%	22.6%	22.0%
Relative to 1990	-	-5.3%	-1.3%	-5.1%	-6.3%	-7.1%	0.2%	-5.7%	-9.0%*	-8.5%†	-10.7%*
1990-2000 trends			**MA trend**			**US Trend**				**Trend comparison** [b]	
Odds ratio			0.9912			0.9893**				0.9982	
Avg. annual change[c]			-0.67%			-0.77%					
Hispanic											
Massachusetts											
Adjusted prevalence	25.9%	14.8%	24.5%	21.7%	15.9%	15.5%	20.1%	12.1%	26.6%	23.8%	19.9%
Relative to 1990	-	-43.0%	-5.3%	-16.3%	-38.6%	-40.2%	-22.2%	-53.3%†	2.5%	-8.0%	-23.3%
US (41 states)											
Adjusted prevalence	19.2%	22.2%	21.0%	20.0%	20.8%	22.4%	22.5%	23.2%	23.1%	21.9%	19.8%
Relative to 1990	-	15.6%†	9.1%	3.8%	8.1%	16.7%*	17.0%*	20.9%**	20.0%*	13.8%†	2.8%
1990-2000 trends			**MA trend**			**US Trend**				**Trend comparison** [b]	
Odds ratio			1.0005			1.0027				0.9986	
Avg. annual change[c]			0.04%			0.23%					

a Adjusted for sex, age, and education.

b Odds ratio of interaction term (Massachusetts by year)

c Derived from coefficient on trend variable, not from annual adjusted prevalence

p-value of logit coefficients: † = <0.10, * = <0.05, ** = <0.01



Discussion

The analysis indicates that the patterns reported in the previous annual report remain stable with the addition of the BRFSS data for 2000. For the 1990-2000 period, current smoking prevalence declined in Massachusetts at a rate that was not only statistically significant, but was significantly different from the trend in 41 states that did not have comprehensive tobacco control programs for most of the period. Massachusetts showed significantly greater declines than the comparison states for the population as a whole and for four specific subgroups: males, persons aged 18-34, persons who had graduated from high school but did not have a college degree, and white non-Hispanic persons.

It is reasonable to conclude that the significant difference between Massachusetts and the 41 comparison states results from the tobacco control initiatives that Massachusetts implemented beginning in 1993. The analysis shows that the faster decline in Massachusetts did not stem from national trends, from demographic changes over time, nor from differences between the demographic composition of Massachusetts and the comparison states. However, because Massachusetts implemented many tobacco control actions during the study period–including tobacco tax increases, media campaigns, community-level education and service programs, and extensive new local and statewide policies–the analysis cannot determine which actions contributed most to the overall result.

The analysis suggests that, although Massachusetts' efforts have had important positive results, they have not been equally effective for all populations. It should be noted, however, that the trend differences across Massachusetts subgroups were not tested for statistical significance (the tests only compared the Massachusetts and comparison state trends for each subgroup). If further analysis shows these differences to be significant, it will be important to seek ways to more effectively reach females, persons age 35-54, persons with less than a high school education, and racial and ethnic minorities.

It is interesting to note that the adjusted prevalence estimate for the 41 comparison states declined by 0.5% from 1999 to 2000, the largest one-year decline since 1991-92. Preliminary examination of the data for 2001, which were released after this analysis was completed, suggests that the prevalence for the 41 states increased in 2001 (the unadjusted prevalence increased from 2000 to 2001 for 29 of the 41 states). Thus there is no evidence that the widespread implementation of new tobacco control programs had moved the national trend downward through 2001. Meanwhile, the unadjusted Massachusetts prevalence declined in 2001, suggesting that the difference between the Massachusetts and US trends probably continued through that year.

Endnotes

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